



Appendix B

Glossary

absorbed dose - Energy absorbed per unit mass from any kind of ionizing radiation in any kind of matter.

activation product - Material made radioactive by exposure to radiation from a source such as a nuclear reactor's neutrons.

adsorption - The accumulation of gases, liquids, or solutes on the surface of a solid or liquid.

anion - A negatively charged ion.

aquifer - Permeable geologic unit that can hold and/or transmit significant quantities of water.

background radiation - Radiation in the natural environment, including cosmic rays from space and radiation from naturally occurring radioactive elements in the air, in the earth, and in our bodies. In the United States, the average person receives approximately 300 millirems of background radiation per year.

bank storage - Hydrologic term that describes river water that flows into and is retained in permeable stream banks during periods of high river stage. Flow is reversed during periods of low river stage.

becquerel (Bq) - Unit of radioactivity equal to one nuclear transformation per second ($1 \text{ Bq} = 1/\text{s}$). Another unit of radioactivity, the curie, is related to the becquerel in which $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$.

boundary dose rate - Dose rate measured or calculated at publicly accessible locations on or near the Hanford Site boundary.

clean closed - A facility is classified as "clean closed" under RCRA regulations when all dangerous waste has been removed and groundwater monitoring is no longer required.

collective effective dose equivalent - Sum of the effective dose equivalents for individuals composing a defined population. The units for this are "person-rem" or "person-sievert."

composite sample - Sample formed by mixing discrete samples taken at different times or from different locations.

confined aquifer - An aquifer bounded above and below by less-permeable layers. Groundwater in the confined aquifer is under a pressure greater than atmospheric pressure.

continuous sample - Sample formed by the continuous collection of the medium or contaminants within the medium during the entire sample period.

controlled area - An area to which access is controlled to protect individuals from exposure to radiation or radioactive and/or hazardous materials.

cosmic radiation - High-energy subatomic particles and electromagnetic radiation from outer space that bombard the earth. Cosmic radiation is part of natural background radiation.

curie (Ci) - A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

decay - The decrease in the amount of any radioactive material with the passage of time, as a result of the spontaneous emission from the atomic nuclei of nucleons or either alpha or beta particles, often accompanied by gamma radiation. When a radioactive material decays, the material may be converted to another radioactive species (decay product) or to a nonradioactive material.

derived concentration guide (DCG) - Concentrations of radionuclides in air and water that an individual could continuously consume, inhale, or



be immersed in at average annual rates, and not receive an effective dose equivalent of greater than 100 millirems per year.

detection level - Minimum amount of a substance that can be measured with a 99% confidence that the analytical result is greater than zero.

dispersion - Process whereby effluents are spread or mixed as they are transported by groundwater or air.

dose equivalent - Product of the absorbed dose, the quality factor, and any other modifying factors. The dose equivalent is a quantity for comparing the biological effectiveness of different kinds of radiation on a common scale. The unit of dose equivalent is the rem. A millirem is one one-thousandth of a rem.

dosimeter - Portable device for measuring the total accumulated exposure or absorbed dose from ionizing radiation fields.

effective dose - See "effective dose equivalent."

effective dose equivalent - A value used for estimating the total risk of potential health effects from radiation exposure. This estimate is the sum of the committed effective dose equivalent (see above) from internal deposition of radionuclides in the body and the effective dose equivalent from external radiation received during a year.

effluent - Liquid or gaseous waste streams released from a facility.

effluent monitoring - Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

exposure - The interaction of an organism with a physical agent (e.g., radiation) or a chemical agent (e.g., arsenic) of interest. Also used as a term for quantifying x and gamma radiation fields (see "roentgen").

external radiation - Radiation originating from a source outside the body.

fallout - Radioactive materials that are released into the earth's atmosphere following a nuclear explosion or atmospheric release and that eventually fall to earth.

fission - The splitting or breaking apart of a nucleus into at least two other nuclei, accompanied with a release of a relatively large amount of energy. For example, when a heavy atom such as uranium is split, large amounts of energy, including radiation and neutrons, are released along with the new nuclei (which are fission products; see below).

fission products - Elements formed from fissioning. Many fission products are radioactive.

gamma radiation - Form of electromagnetic, high-energy radiation emitted from a nucleus. They require heavy shielding (e.g., concrete, steel) to be stopped and may cause biological damage when originating internally or externally to the body in sufficient amounts.

grab sample - A sample that is randomly collected or "grabbed" from the collection site.

grand mean - A "means of means" or an "overall mean" where there is some subdivision of the data where means were already provided for each subdivision.

groundwater - Subsurface water that is in the pore spaces of soil and geologic units.

gray (Gy) - Unit of absorbed dose in the International System of Units (SI) equal to 1 joule per kilogram. 1 Gy = 100 rad.

half-life - Length of time in which a radioactive substance will lose one half of its radioactivity by decay. Half-lives range from a fraction of a second to billions of years, and each radionuclide has a unique half-life.

ion exchange - The reversible exchange of one species of ion for a different species of ion within a medium.



irradiation - Exposure to radiation.

isotopes - Radionuclides (or nuclides) with the same number of protons (same atomic number) but a different number of neutrons (different mass). Isotopes of the same element (e.g., ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Pu) have almost identical chemical properties.

lysimeter - An instrument to measure the water percolating through soil and determine the materials dissolved by the water.

maximally exposed individual - A hypothetical member of the public residing near the Hanford Site who, by virtue of location and living habits, could receive the highest possible radiation dose from nuclides/radiation originating from Hanford.

mean - Average value of a series of measurements. The mean, \bar{X} , was computed as:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

where n is the number of measurements and X_i is the i th measurement.

median - Middle value in a set of results when the data are ranked in increasing or decreasing order.

millirem - A unit of radiation dose equivalent that is equal to one one-thousandth (1/1000) of a rem. According to U.S. Department of Energy standards, an individual member of the public may receive no more than 100 millirems per year from a site's operation. This limit does not include radiation received for medical treatment or the ~300 millirems that people receive annually from natural background radiation.

minimum detectable concentration - Smallest amount or concentration of a radioactive or nonradioactive element that can be reliably detected in a sample.

mitigation - Prevention or reduction of expected risks to workers, the public, or the environment.

noble gas - Any of a group of chemically and biologically inert gases that includes argon, krypton, and xenon. These gases are not retained in the body following inhalation. The principal exposure pathways for radioactive noble gases are direct external dose from the surrounding air.

nuclide - A general term referring to all known isotopes, both stable and unstable, of the chemical elements (Shleien 1992).

offsite locations - Sampling and measurement locations outside the Hanford Site boundary.

onsite locations - Sampling and measurement locations within the Hanford Site boundary.

operable unit - A discrete area for which an incremental step can be taken toward comprehensively addressing site problems. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site.

outfall - End of a drain or pipe that carries wastewater or other effluents into a ditch, pond, or river.

plume - The cloud of a pollutant in air, surface water, or groundwater formed after the pollutant is released from a source.

plutonium - A heavy, radioactive, man-made metallic element consisting of several isotopes. One important isotope is ^{239}Pu , which is produced by the irradiation of ^{238}U . Routine analysis cannot distinguish between the ^{239}Pu and ^{240}Pu isotopes; hence, the term $^{239/240}\text{Pu}$ as used in this report is symbolic of the presence of one or both of these isotopes in the analytical results.

quality assurance - Actions that provide confidence that an item or process meets or exceeds that user's requirements and expectations.

quality control - Comprises all those actions necessary to control and verify the features and characteristics of a material, process, product, or service to specified requirements. Quality control is an element of quality assurance.



rad - A special unit of absorbed dose equal to 100 ergs/g or 0.01 J/kg.

radiation - The energy emitted in the form of photons or particles such as those thrown off by transforming (decaying) atoms. For this report, radiation refers to ionizing types of radiation; not radiowaves, microwaves, radiant light, or other types of nonionizing radiation.

radioactivity - Property possessed by some isotopes of elements of emitting radiation (such as alpha, beta, or gamma photons) spontaneously in their decay process to stable element isotopes.

radioisotope - An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation (Shleien 1992).

radionuclide - A species of atoms having a particular number of protons (Z), a particular number of neutrons (A), and a particular atomic weight ($N = Z + A$) that happens to emit radiation. Carbon-14 is a radionuclide. Carbon-12 is not and is called just a "nuclide."

recruitment - Survival from one life form or stage to the next or from one age class to the next.

rem - A unit of dose equivalent and effective dose equivalent.

remediation - Reduction of known risks to the public and environment to an agreed upon level.

risk - The probability that a detrimental health effect will occur.

roentgen (R) - Unit of x ray or gamma photon exposure measured in air, historically used to describe external radiation levels. An exposure of 1 roentgen typically causes an effective dose of 1 rem.

sievert (Sv) - Unit of dose equivalent and effective dose equivalent in the International System of Units (SI) equal to 100 rem.

specific retention facilities - Historical structures consisting of cribs, ditches, trenches, or holes in the ground that received relatively small volumes of high concentration liquid radioactive waste. The small volume of liquid waste was designed to prevent flushing of the contaminants through the soil column to the groundwater.

spectrometer - A spectroscopy with a calibrated scale for measuring the positions of spectral lines.

spectroscopy - The branch of physics concerned with the production, measurement, and interpretation of electromagnetic spectra arising from either emission or absorption of radiant energy by various substances.

spent fuel - Uranium metal or oxide and its metal container that have been used to power a nuclear reactor. It is highly radioactive and typically contains fission products, plutonium, and residual uranium.

standard error of the mean - A measure of the precision of a mean of observed values; that is, an estimate of how close a mean of observed values is expected to be to the true mean. The standard error (SE) of the mean is computed as

$$SE = \sqrt{\frac{S^2}{n}}$$

where S^2 is the variance of the measurements, n , computed as

$$S_M^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2$$

This estimator, S^2 , includes the variance among the samples and the counting variance. The estimated S^2 may occasionally be less than the average counting variance.

thiourea - An organic chemical soluble in cold water used in photography, photocopying, and thyroid medication.



transuranic - An element with an atomic number greater than 92 (92 is the atomic number of uranium).

thermoluminescent dosimeter - A device containing a material that, after being exposed to beta and/or gamma radiation, emits light when processed and heated. The amount of light emitted is proportional to the absorbed dose to the thermoluminescent dosimeter.

unconfined aquifer - An aquifer containing groundwater that is not confined above by relatively impermeable rocks. The pressure at the top of the unconfined aquifer is equal to that of the atmosphere. At Hanford, the unconfined aquifer is the uppermost aquifer and is most susceptible to contamination from site operations.

Reference

Shleien, B. (ed.). 1992. *The Health Physics and Radiological Health Handbook, Revised Edition*. Scinta, Inc., Silver Spring, Maryland.

vadose zone - Underground area from the surface to the top of the water table or aquifer.

volatile organic compounds - Lightweight organic compounds that vaporize easily. Used in solvents and degreasing compounds as raw materials, volatile compounds are generally considered to be below the molecular weight of C₁₀ hydrocarbons.

water table - Theoretical surface represented by the elevation of water surfaces in wells penetrating only a short distance into the unconfined aquifer.

wind rose - Star-shaped diagram that shows how often winds of various speeds blow from different directions, usually based on yearly averages.